ACP- ACTAE Project
Agroecological Crop Protection

Highlights of the International Scientist School Agroecological Crop Protection

Can Tho (Vietnam), 11–16 March 2018

1. Background

In South-East Asia in general and especially in Vietnam, Laos, Cambodia and Myanmar, agriculture faces a wide range of constraints, including the rapidly changing demand for agricultural production (quantity, quality and safety), the impacts of climate change, the impacts of inputs on health and the environment. Crop Protection has relied for a long time on agrochemicals but is now at a defining moment. Although pesticides have been condemned for many years, the problems encountered with this type of Crop Protection are becoming more frequent and acute: inefficiency in many situations; resistance to pesticides; soil, water, and air pollution; hazards to human health; and loss in biodiversity.

In this context, the challenge of agronomic research is: ii) now to move from this chemical-based approach to that of pest prevention with more balanced and sustainable agroecosystems; ii) to answer both the current questions questions (in particular to improve the socio-economic viability of the stakeholders) and those of tomorrow (in particular to design and implement ecologically sustainable agroecosystems). Agroecology appears to be an appropriate and relevant way to respond to this challenge.

2. Agroecological Crop Protection

Agroecological Crop Protection (ACP) is the declension of Agroecology to Crop Protection and it is at the crossroad of Agroecology and Crop Protection. It aims at "replacing" chemicals, which have negative effects on the environment and on human health, by the services offered by functional biodiversity above and below soil surface. By focusing on preventive measures, it aims at establishing a bioecological balance between plant and animal communities within an agroecosystem in order to prevent or reduce the risk of infections or outbreaks of pests' outbreaks. ACP is based on 2 axis: i) enhance biodiversity (vegetal/animal) and ii) soil health. It is therefore very consistent and complementary to Conservation Agriculture, devoted to agroecosystem soil management. ACP is another field of agroecosystem field study and management, devoted to prevention and management of pests. It is now well documented.

The three pillars of implementation of ACP are sanitation, habitat management and biological control. New scales of intervention are considered, both in terms of space and time in accordance with participatory, global and systemic approaches. The implementation of the ACP principles to the field reality have shown good results in different parts of the world and some success stories have been described, for example in horticultural crops or fruit crops. Keys of agroecological transition are now available and can be adapted to different contexts, for example SEA context.

3. ACP-ACTAE project

ACTAE is a regional project, funded by AFD (French Agency for Development) and Cirad, aimed at promoting agro-ecological principles and practices in Cambodia, Lao PDR, Myanmar and Vietnam. The overall objective of ACTAE project is to build sustainable and effective mechanisms to facilitate synergies among initiatives contributing to an agroecological transition in South East Asia between Research, Extension and Farmers.

The overall object of the "Agroecological Crop Protection (ACP) ACTAE project is, by starting and promoting activities in a new field of Agroecology, to contribute to the global development of Agroecology in SEA through 3 specific purposes: i) Making a state of the art of Crop Protection in the zone and identifying the priority issues of Crop Protection that must be taken into account; ii) Training and information exchanging on ACP for stakeholders (including training sessions and the organization of an International Scientist School); iii) Building the foundation of a ACP medium term project, integrating research, training, education and extension support (including already identified deliverables) with CANSEA partners.

We have to consider this project as a framework to start basic activities (survey, exchange of information, training) and as a leverage to build a medium term ACP research project for CANSEA (2020-2024), with current and new technical and financial partners.

Meetings and seminars planned in this proposal are destined to all ACTAE countries (Vietnam, Myanmar, Laos, Cambodia), such as workshops and International Summer School (see below). But, taking into account the limited amount of the requested budget, this ACP proposal will particularly focus on developing partnership with two countries: Vietnam and Myanmar.

4. Can Tho International Scientist School

After the three previous ACP-ACTAE Workshops held in Hanoi (Vietnam, 25-26 April, 2017), in Nay Pyi Taw (Myanmar, 3-5 May, 2017) and in My Tho (Vietnam, 29-31, August 2017), this International Scientist School was the main event of the year 2018 in the ACP-ACTAE project. It is co-organized by Cirad, Can Tho University and Inra and it was held in Can Tho University (Faculty of Agronomy). It has an international level, including the participation of colleagues from Vietnam, Cambodia, Lao, Myanmar and France.

The Can Tho International Scientist School was linked with the International Scientist School previously held in Volterra (Italy, 11-16 February, 2018) on Agroecological Crop Protection. They are "Twin Scientist Schools" in the agroecological landscape (annex 1).

The principles, approaches, axes, pillars and implementation stratégies of Agroecological Crop Protection (ACP) at the field and lanscape levels are not the same as those known to date. Therefore, ACP represents a new field of research and applications yet to be thoroughly studied and disseminated. In line with current objectives assigned to crop protection, ACP

creates a breakthrough in cropping system design and in the management of interstitial spaces, switching from agrochemistry to agroecology. ACP is the underlying framework of this International Scientist School: review of the principles of ACP, critical analysis of the evolution of Crop Protection, and results of participatory experiments under various production systems. Particular attention is paid to the role of modelling approaches in designing agroecological cropping systems based on ACP, as well as on activities in this new context, with specific reference to researchers (e.g. new knowledge to be acquired, multicriteria evaluation, inter-disciplinarity). Finally, this International Scientist School proposes practical recommendations to help implement the agroecological transition, especially for South-East Asian agroecosystems.

The objectives of this Scientist School were:
- to better know and understand the concepts of ACP, methods and tools for their implementation and jointly exchange the principles of ACP
- to engage participants in a collective dynamic of ACP and develop collaborations as well as research projects, with concrete deliverables, videos, articles, and training resources

The lecturers of the International Scientist School on ACP were: Dr Jean-Noël Aubertot (INRA, France), Dr Philippe Cao Van (Cirad, Laos), Dr Jean-Philippe Deguine (CIRAD, Réunion), Dr Duong Minh Vien (CTU, Vietnam), Pr Le Van Vang (CTU, Vietnam), Dr Nguyen Thi Ngoc Truc (Sofri, Vietnam), Dr Pham Thi Sen (Nomafsi, Vietnam), Dr Philippe Tixier (Cirad, France), Dr Kris Wyckhuys (Asia Entomology, Vietnam/China). In addition, Dr Sen (Nomafsi) gave a presentation on Conservation Agriculture in South East Asia.

23 participants from different countries of South East Asia and 8 lecturers attended this International Scientist School.

5. Organization and Scientific Committee

- Dr Jean-Noël Aubertot (INRA, France)
- Dr Philippe Cao Van (Cirad, Laos)
- Dr Jean-Philippe Deguine (Cirad, France)
- Dr Duong Minh Vien (CTU, Vietnam)
- Pr Le Van Vang (CTU, Vietnam)
- Mrs Lim Ngoc Han (CTU, Vietnam)
- Dr Nguyen Thi Ngoc Truc (Sofri, Vietnam)
- Dr Kris Wyckhuys (Asia Entomology, Vietnam/China)

5 members of this committee attended, as participants (Dr Nguyen Thi Ngoc Truc (Sofri, Vietnam) & Dr Philippe Cao Van (Cirad, Laos)) or as lecturers (Dr Jean-Philippe Deguine (Cirad, Réunion), Dr Jean-Noël Aubertot (INRA, France) & Dr Kris Wyckhuys (Asia Entomology, Vietnam/China)), the International Scientist School in Volterra, insuring the consistency and the scientific links between the “twin ACP ISSs”.

Official Group Photography in Can Tho University

Group photography during the field trip

6. Program, International Scientist School (Can Tho, 11-16 March 2018). Can Tho University (Faculty of Agronomy)

Group presentations or activities
Lectures
Workshops or group projects
Field trip

Day 0. Sunday 11 March.
Tour in Mekong Delta

Day 1. Monday 12 March.
Introduction to the ISS & Agroecological Crop Protection

am/ pm	hours	Topic	Presenter, coordinator
am	Chair: Pr Le Van Vang (CTU)		
	8:30	Opening ceremony	Pr Le Van Hoa, Dean of the Faculty of Agriculture, CTU
	8:45	Introduction to the TC	Dr P. Cao Van, Pr Le Van Vang
	9:15	Program Presentation	Dr Deguine, Dr Nguyen Thi Ngoc Truc
	9:30	Participant presentation	all
	10:00	Group photography	all
	10:30	Coffee break	
	11:00	Challenges and changes in Crop Protection in SEA	Dr Cao Van
	11:30	Principles of ACP	Dr Deguine
pm	Chair: Dr Nguyen Thi Ngoc Truc (Sofri/Vaas) & Dr Jean-Philippe Deguine (Cirad)		
	13:30	From IPM to ACP	Dr Cao Van
	14:00	ACP against arthropods	Dr Deguine
	14:30	ACP against pathogens	Dr Aubertot
	15:00	ACP against nematodes	Dr Tixier
	15:30	ACP against weeds	Dr Cao Van and Dr Sen
	15:45	Coffee break	
	16:00	Parallel WS 1 : Biodiversity & BC	Dr Nguyen Thi Ngoc Truc, Dr Tixier & Pr Le Van Vang
		Parallel WS 2 : Soil health	Dr Cao Van, Pr Duong Minh Vien & Dr Tran Van Thinh

Day 2. Tuesday 13 March.
Modelling

am/ pm	hours	Topic	Presenter, coordinator
am	Chair: Dr Philippe Cao Van (Cirad)		
	8:30	Introduction to modelling	Dr Aubertot
	9:00	Example of modelling: qualitative modelling using IPSIM	Dr Nguyen Thi Ngoc Truc
	9:30	Example of modelling: modelling for the ecological control of the banana weevil	Dr Tixier
	10:00	Example of modelling: IPSIM Chayote in Réunion	Dr Deguine
	10:15	Coffee break	
	10:30	Approaches & Methodology	Dr Aubertot
	11:00	How to produce knwoledge in Science?	Dr Aubertot
	11:30	Definition of SEA modelling projects	Dr Aubertot
pm	Chair: Dr Jean-Noël Aubertot (Inra)		
	13:30	Group session on modelling projects	all
	15:00	Coffee break	
	15:30	Parallel WS 1 & 2 (continued)	Dr Nguyen Thi Ngoc Truc, Dr Tixier & Pr Le Van Vang Dr Cao Van, Pr Duong Minh Vien & Dr Tran Van Thinh

Day 3. Wednesday 14 March.
Field Trip

am/ pm	hours	Topic	Presenter, coordinator
Coordination : Mrs Lim Ngoc Han, Pr Le Van Vang & Dr. Duong Minh Vien (CTU)			
am & pm	8:30	Field Trip	all
diner	19:00	on the boat / Mekong	all

Day 4. Thursday 15 March.
ACP research topics & Case studies

am/ pm	hours	Topic	Presenter, coordinator
am	Chair : Dr Jean-Philippe Deguine (Cirad)		
	8:30	The need of new approaches in Crop Protection: case study and lessons	Dr Kris Wyckhuys
	9:00	Insect Semiochemicals: Research and Application	Pr Le Van Vang
	9:30	Biocontrol: Bioproducts	Dr Nguyen Thi Ngoc Truc
	10:00	Coffee break	
	10:30	Biodiversity and natural control of pest and diseases in banana systems	Dr Tixier
	11:00	Functional Biodiversity in mango orchards in Réunion Island	Dr Deguine
	11:30	Soil Health: Conservation agriculture in South East Asia	Dr Sen
pm	Chair : Dr Kris Wyckhuys (Asia Entomology)		
	13:30	Pesticide uses in different cropping systems: a case sudy in Mekong Delta	Dr. Duong Minh Vien
	14:00	Biodegradation of soil chlorinated organic toxic compounds	Dr. Duong Minh Vien
	14:30	Agroecological Crop Protection on Rice in Mekong Delta	Pr Le Van Vang
	15:00	Coffe break	
	15:30	French West Indies Banana : how changes were possible ?	Dr Tixier
	16:00	Quantification of pest populations and injuries, with specific references to French agriculture	Dr Aubertot
	16:30	Parallel WS 1 & 2 (continued)	all

Day 5. Friday 16 March.
Restitution and conclusion

am	Chair: Dr. Duong Minh Vien (CTU)		
	8:30	Restitution of the WS Biodiversity & BC	Dr Nguyen Thi Ngoc Truc, Dr Tixier & Pr Le Van Vang
	9:00	Restitution of the WS Soil health	Dr Cao Van, Pr Duong Minh Vien & Dr Tran Van Thinh
	9:30	Restitution of the modelling projects	Dr Aubertot and participants
	10:00	Coffee break	
	10:30	ISS feedback	Dr Nguyen Thi Ngoc Truc & Pr Le Van Vang
	10:45	Links between Twin Volterra and Can Tho ISS	Dr Aubertot & Dr Wyckhuys
	11:00	Presentation of certificates and awards	Dr Deguine & Dr Cao Van
	11:30	Perspectives	Dr Cao Van
	11:45	Closing session	CTU Representative

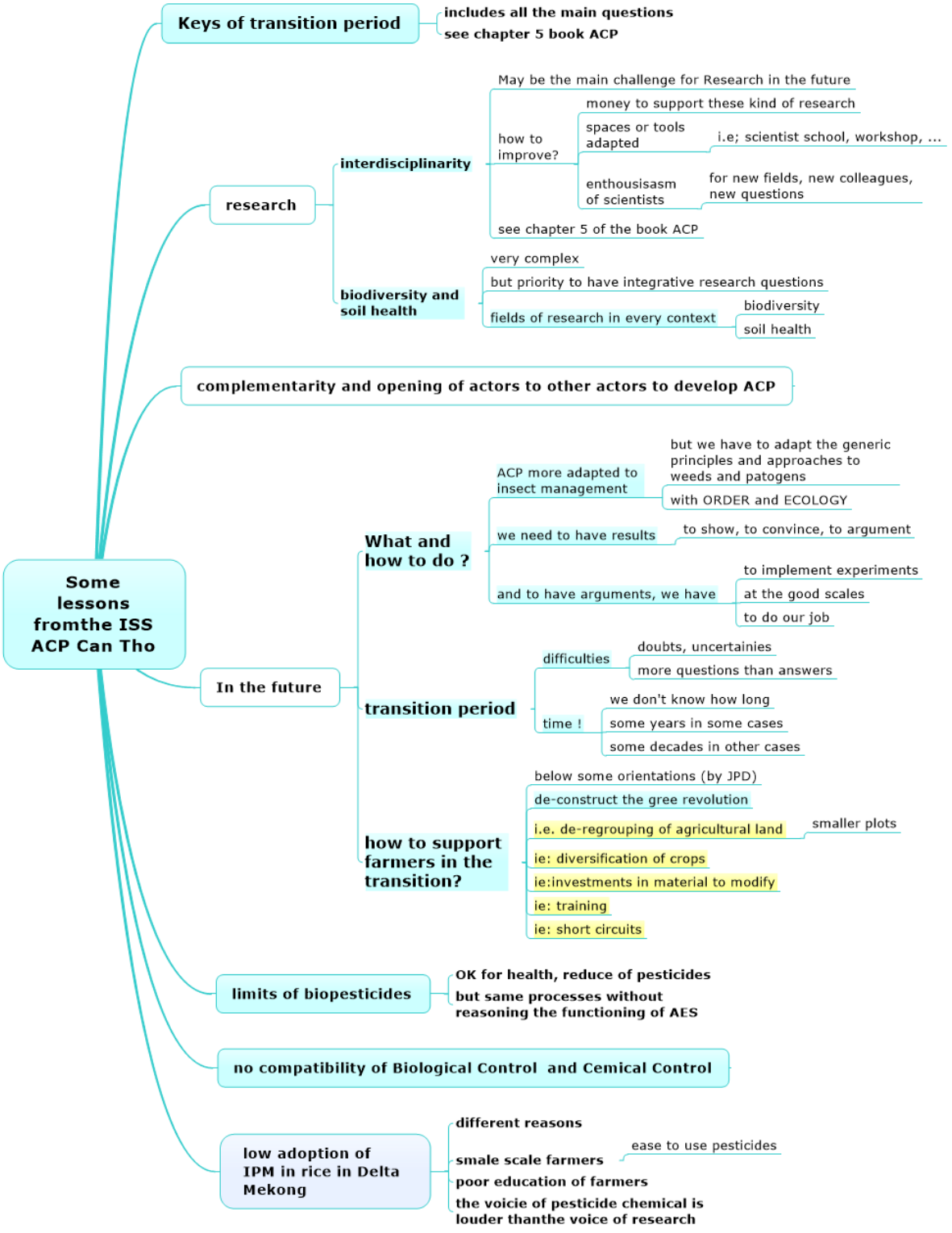
At the end of the Scientist School, a USB key was given to each participant with:
- all presentations of the ISS ACP Can Tho
- some publications related to the ACP topic
- a selection of photos taken during the ISS ACP Can Tho
- publications and documents given to the ISS ACP Volterra
- the contacts of the participants

7. List of participants

	Country	Name	Institution	Email	Remark
1	Laos	Dr Pheophanh Soysouvanh	PPC / MAF	pheophanhs@gmail.com	Entomologist
2		Ms Khonesavanh Chittarath	PPC / MAF	chittarhat_2005@yahoo.com	Plant pathologist
3		Mr Thisadee Chounlamountry	DALaM / MAF	thisadeec@hotmail.com	Agronomist
4	Cambodia	Mr Sereyboth Soth	RUA	sereybothsoth@gmail.com	Plant pathologist
5	Vietnam (Hanoi)	Dr Pham Thi Sen	NOMAFSI / MARD	phamthisenprc@gmail.com	Agronomist
6		Mr Nguyen Nam Hai	PPRI / MARD	hainguyen309@gmail.com	Entomologist
7		Dr Nguyen Duy Phuong	SFRI / MARD	ndpptn@yahoo.com	Soil science
8		Mrs Bui Thi Suu	Tay Bac University	buithisuutbu@gmail.com	Entomologist
9	Vietnam (South)	Dr Dinh Thi Yen Phuong	IFAM	phuong.dinh@wsu.edu	Plant pathologist
10		Dr Tran Thi My Hanh	SOFRI	hanhvcaq7@gmail.com	Entomologist
11		Mrs NGUYEN Khanh Ngoc	SOFRI	khanhngoc012016@gmail.com	Plant pathologist
12		Ms Nguyen Thi Phung Kieu	Nong Lam University	Kieunguyen0306@gmail.com	Entomologist
13		Dr Tran Van Thinh	Nong Lam University	tranvanthinh@hcmuaf.edu.vn	Soil Sciences
14		Dr Pham Thi Hoa	Lam Dong Plant Protect	thihoap@gmail.com	Plant pathologist
15		Dr Nguyen Minh Chau	IFAM	chausofri@gmail.com	Agronomist
16	VN -Can Tho University	Dr Nguyen Thi Thu Nga	CTU	nttnga@ctu.edu.vn	Plant Pathologist
17		Dr. Le Thanh Toan	CTU	lttoan@ctu.edu.vn	Plant Pathologist
18		Dr. Trinh Thi Xuan	CTU	trinhthixuan@ctu.edu.vn	Biological control
19		Ms Nguyen Hong Ung	Tra Vinh Univ	nghongung@tvu.edu.vn	Entomologist
20		Mr Tran Van Khai	CTU	tvkhai@agu.edu.vn	Entomologist
21		Mr Pham Nguyen Anh Duy	CTU	pnaduy@ctu.edu.vn	Entomologist
22		Mr Chau Nguyen Quoc Khanh	CTU	cnqkhanh@ctu.edu.vn	Entomologist
23		Ms Duong Kieu Hanh	CTU	dkhanh@ctu.edu.vn	Entomologist
24	France	Dr Philippe Tixier	CIRAD-GECO	Philippe.tixier@cirad.fr	Modelisator
25		Dr Guy Lambert	Université Aix	guy.lambert@univ-amu.fr	
26	Organization Committee	Dr Jean-Philippe Deguine	CIRAD-PVBMT	jean-philippe.deguine@cirad.fr	Entomologist
27		Dr Jean-Noël Aubertot	INRA	jean-noel.aubertot@inra.fr	Entomologist
28		Prof Le Van Vang	Can Tho University	lvvang@ctu.edu.vn	Entomologist
29		Dr Nguyen Thi Ngoc Truc	SOFRI	nguyentrucvietnam@gmail.com	Microbiologist
30		Mrs Lim Ngoc Han	Can Tho University	lnhan@ctu.edu.vn	
31		Dr. Duong Minh Vien	Can Tho University	dmvien@ctu.edu.vn	Soil Sciences
32		Dr Kris AG Wyckhuys	Asia Entomology	kagwyckhuys@gmail.com	Entomologist
33		Philippe CAO-VAN	CIRAD-ACTAE	caovan@cirad.fr	Agronomist

8. Some scientific highlights emerged from the Scientist School

Some lessons from the ISS ACP Can Tho



Main conclusions of the Biodiversity & Soil Health Working Groups

The conclusions are given in ppt files in annex 2.

The WG on Soil Health proposes 5 questions that could be the bases of a Partnership project or the content of a Scientist School. The questions require interdisciplanitity between agronomists, soil specialists, crop protection specialists, human and social scientists …

The topic on "interactions between aerial and soil biodiversity" is crossing the priorities of the two Working Groups. One part of the chapter 5 of the book "Agroecological Crop Protection" is devoted to this topic.

Main conclusion of the Modeling Working Group

After a brief introduction to conceptual modeling and modeling technics to design simulation models, a hands-on project was conducted by seven group. The topics addressed by the 7 teams were the followings.

1. Control Lesion Nematode on Groundnut
Dr Nguyen Thi Thu Nga (Can Tho University), Mr Soth Sereyboth (Royal University of Cambodia), Dr Le Thanh Toan (Can Tho University)

2. Factors impacting the control of the Asian citrus psyllid Diaphorina citri
Dr Khai Tran Van (An Giang University), Dr Ngoc Nguyen Khanh (Sofri), Dr Xuan Trinh Thi (Can Tho University), Dr Kieu Nguyen Thi Phung (Nong Lam University)

3. Prediction of the outbreak of brown plant hopper Nilaparvata lugens
Dr Pham Thi Sen (Nomafsi), Dr Nguyen Duy Phuong (SFRI), Mr Nguyen Nam Hai (PPRI)

4. Control of stem borer on coffee
Dr Pham Thi Hoa (Lam Dong University), Ms Nguyen Thi Hong Ung (Tra Vinh University), Dr Tran Thi My Hanh (Sofri), Dr Dinh Thi Yen Phuong (IFAM)

5. Evaluate the risk of TR4 on banana in South East Asia
Dr Philippe Tixier (Cirad), Dr Khonesavanh Chittarah (Laos), Dr Nguyen Thi Ngoc Truc (Sofri)

Two other groups worked on :
- optimisation of rice production under water stress
- management of fruit flies on mango.

Each group presented the question addressed, the conceptual model designed, its implementation under the IPSIM/DEXI framework, simulation results and a short discussion.

This first experience on modelling permitted to participants to better understand what are the potentialities of modeling approaches applied to ACP.

9. Evaluation of the Scientist School

The 23 participants filled the evaluation form (see annex 3) at the end of the International Scientist School.

They claimed that the International Scientist School totally (95%) matched their expectations. They have got knew knowledge and more experience on ACP, initiation to qualitative modelling, and they appreciated to have meeetings and scientific discussions with international experts.

60% of the participants considered that the school was of an appropriate length. The other 40% should prefer to have more time (7 to 10 days for the ISS).

The global objectives of the ISS were very well met (83%). Considering the scale of satisfaction of the evaluation form (poor=1 ; satisfactory=2 ; good=3 ; very good=4 ; excellent=5), the specific objectives were met as follows :
- to better know and understand the concepts of ACP : 3,91/5
- to better know methods and tools for implementation of ACP : 4,09/5
- to jointly exchange the principles of ACP : 4,23/5
- to engage participants in a collective dynamic of ACP and develop collaborations as well as research projects : 4,13/5
- for the collective dynamics, to plan concrete deliverables, videos, articles, and training resources : 4,06/5

The organization was considered as very good for 79% of the participants, for the following aspects : accommodation (bedrooms, food), conference rooms, staff availability, location, upstream organisation (registration, availability to answer questions), local organisation.

The appreciation of the contents of the days (excluding the field trip on Day 3) were the followings (poor=1 ; satisfactory=2 ; good=3 ; very good=4 ; excellent=5).

Day 1. Agroecological Crop Protection. Principles and examples (lectures)
Very good for 87% of the participants (average score: 4,19/5)

Day 2. Modelling (lectures and group projects)
Very good for 85% of the participants (average score: 4,27/5)

Day 4. ACP research topics and case studies (lectures)
Very good for 80% of the participants (average score: 3,98/5)

Day 5. Restitution and conclusion (group projects and working groups)
Very good for 87 % of the participants (average score: 4,08/5).

For the lecturers, the ISS was very pleasant and useful and they thought that participants were very active and reactive and they strongly participated in the working groups and the group projects.

Some take-home messages of this ISS were given by the participants:
- ACP can be applied in the future in SEA
- qualitative modelling is a very useful approach to consider « complexity »
- Interdisciplinarity is necessary to develop ACP
- Soil health and biodiversity are the two main axes of ACP

Some challenges for the future :
- links between ACP concepts and policers
- ACP is consistent with Organic agriculture
- how to improve the connexion between soil health and biodiversity ?

Some actions or thematics discussed in the ISS will be implemented in the research activity of the participants. They stressed on the following topics : biodiversity, soil health, sanitation, augmentorium, coservation biological control, cover crops, modelling, qualitative modelling, bioagents, organic agriculture.

Some live feedbacks from the participants:
« *ACP is important for my country* ».
« *ACP is good to get organic products* ».
« Agroecology Crop Protection is likely to apply arts into agriculture ».
« *Before the ISS, I was not a modeller. Now I am a modeller* ».
« *I appreciated the very good rythm of ISS, with lectures, group projects, working groups, and restitution in plenary session ».*
« The field tour was useful to understand the links between concepts and farm realities ».
« It was great to share with the international experts and learn from their knowledge and experiences from around the world ».

Annex 1. The ACP Twin Scientist Schools

Volterra and Can Tho ISSs: surroundings

Volterra and Can Tho ISSs: group photography

Volterra and Can Tho ISSs: plenary session


Volterra and Can Tho ISSs: modelling working groups


Volterra and Can Tho ISSs: Biodiversity & Soil Health working groups


Volterra and Can Tho ISSs: convivial diner


Volterra and Can Tho ISSs: field trip

Annex 2. Conclusions of the Soil Health and the Biodivesrity Working Groups

Soil Health Group

cirad
AGRICULTURAL RESEARCH FOR DEVELOPMENT

Soil health

Working group:
Dr. Philippe Cao Van
Dr. Jean-Philippe Deguine
Dr. Jean-Noel Aubertot
Dr. Duong Minh Vien
Dr. Tran Van Thinh
Dr. Nguyen Minh Chau
Dr. Phan Thi Sen
Mr. Nguyen Nam Hai
Mr. Thisadee Chounlamountry
Ms. Bui Thi Suu
Dr. Nguyen Duy Phuong
Dr. Dinh Thi Yen Phuong

ACTAE
UMR pvbmt
AFD
INRA

International Scientist School Agroecological Crop Protection
Can Tho, 11-16 March 2018

Soil health

- Definition
- Soil indicators
- Soil health assessment
- Soil health management
- Research questions

Soil health definition

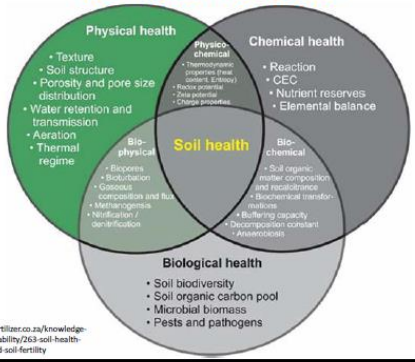
- Karlen et al., 1997: the capacity of soil to function as a vital living system, within ecosystem and land-use boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality and promote plant, animal and human health...
- Serve as a firm foundation for agricultural activities, provide habitat for microbes to flourish and diversify → ecosystem running smoothly
- Can be managed

Soil functions

- Regulating water
- Sustaining plant and animal life
- Filtering and buffering potential pollutants
- Cycling nutrients
- Physical stability and support

Natural Resources Conservation Service Soils-USDA

Soil health indicators



http://www.fertilizer.co.za/knowledge-centre/sustainability/263-soil-health-looking-beyond-soil-fertility

Soil health assessment tools

- Qualitative Scorecards (questionnaires and observation...)
- Field Test Kits (pH/EC meter, tensimeter...)
- Lab-based assessments (HPLC, GC-MS, ...)
- Practice Predictors: use research outcome to predict the effects of management practices on soil quality
  - NRCS Soil and Water Eligibility Tool (SWET)
  - Conservation Measurement Tool (CMT)
- Landscape-level assessment (satellite, remote sensors...)

Natural Resources Conservation Service Soils (NRCS)-USDA

INDICATORS	BEST TIME FOR ASSESSMENTS OF INDICATORS		
	Stage of Crop Growth	Moisture Conditions	Tillage
Earthworms	Pre-plant, active growth	Good soil moisture	Before
Soil Organisms	Pre-plant, active growth	Good soil moisture	Before
Smell	Anytime	Adequate soil moisture	Anytime
Organic Material	Pre-plant, active growth	NA	After
Residue Decomposition	Anytime	Adequate soil moisture	NA
Compaction	Anytime	Adequate soil moisture	Anytime
Workability	Pre-plant, post harvest	Adequate soil moisture	During tillage
Soil Tilth/Structure	Pre-plant, active growth	Adequate soil moisture	Anytime
Soil Aggregates	Pre-plant, active growth	Adequate soil moisture	Not too soon prior to or after tillage
Porosity	Pre-plant, active growth	Adequate soil moisture	Not too soon prior to or after tillage
Crusting	Pre-plant, active growth	Adequate soil moisture	Anytime
Water Infiltration	Anytime	After irrigation or rain	Not too soon prior to or after tillage
Drainage	Anytime	After irrigation or rain	Anytime
Water Holding Capacity	Pre-plant, active growth	After irrigation or rain	Anytime
Wind or Water Erosion	Anytime	Any	Anytime
Crop Vigor/Appearance	Active growth	Adequate soil moisture	NA
Plant Roots	Active growth	Adequate soil moisture	NA
Root Mass	Active growth	Adequate soil moisture	NA
Salts	Any	Any	Any
Sodium	Any	Any	Any

NOTE: This calendar is approximate. Tailor it to local climates, cropping systems, and soil types

NRCS Soil Health Card Template

Operator Name_____ **Date of Visit**_____ **Field/Farm ID**_____

INDICATOR	RANKING			SCORING		
	Low	Medium	High	Circle one		
Earthworms	Few worms per shovel, no casts or holes	More worms per shovel, some casts or holes	Many worms per shovel, many casts or holes.	L	M	H
Soil Organisms	Few insects, worms, fungi, or soil life	Some insects, worms, fungi, soil life	Many insects, worms, fungi, soil full of variety of organisms	L	M	H
Smell	Swampy smell	Little or no smell	Fresh earthy smell	L	M	H
Surface Organic Material	No visible roots or residue	Some residue	Lots of roots/residue in many stages of decomposition	L	M	H
Residue Decomposition	Very slow decomposition, or rapid decomposition	Some visible, non-decomposed residue	Residue at various stages of decomposition	L	M	H
Compaction	Hard layers, tight soil, restricted root penetration, obvious hardpan, roots turned awkwardly	Firm soil, slightly restricted root penetration, moderate shovel resistance and penetration of wire flag beyond tillage layer	Loose soil, unrestricted root penetration, no hardpan, mostly vertical root plant growth	L	M	H
Workability	Many passes and horse-power needed for good	Soil works reasonably well	Tills easily and requires little power to pull	L	M	H

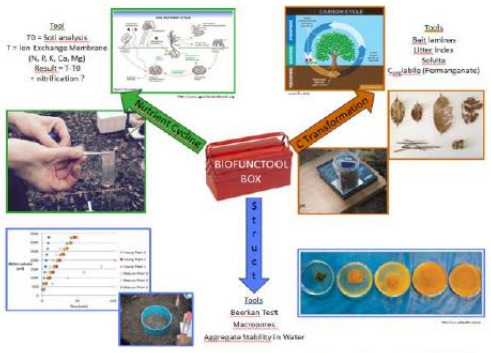

CORNELL SOIL HEALTH TEST REPORT

	Indicators	Value	Rating	Constraint
PHYSICAL		40.0	60	
		0.14	54	
		288	0	Cracking, water transmission
		467	0	Subsurface Pan/Deep Compaction
BIOLOGICAL		4.2	70	
		384	100	Soil Biological Activity
		3.4	0	N Supply Capacity
		5.5	50	
CHEMICAL		5.5	0	Toxicity, Nutrient Availability (for crop specific guide, see CNAL report)
		13.5	100	
		70.4	100	
			56	
OVERALL QUALITY SCORE (OUT OF 100)		43.1	Low	

Soil Textural Class: sandy loam

Soil function assessment

- Kibblewhite et al., 2008: soil quality depend on 3 major ecosystem functions
  - Carbon transformation
  - Nutrient cycling
  - Soil structure maintenance
- Soil organisms: major roles in soil functioning and as relevant indicators of soil health (by Microresp)



Schematic description of the "Biofunctool" tool box (LMI LUSES)

Soil erosion and degradation

- Exposed soil
- Wind
- Rain
- Human activities: dam construction, deforestation, tillage, intensive cultivation, chemical uses….

Soil health management

- To have sustainable soil health for future generation
- Soil health & Biodiversity are the two pillars of Agroecological Crop Protection

Soil health management

- Manage organic matter
- Minimize disturbances
- Diversify soil biota
- Maintain soil cover
- Crop rotation
- Cover crops and green manures
- Organic amendments
- Conservation tillage

Research questions

- How to predict soil health in the field based on the soil analyse reports?
- What are the relevant indicators to describe soil health for ACP?
- How agroecological practices can contribute to the improvement of soil health?
- What are the main challenges for farmers to face on the fields with regard to soil health?
- What and how to measure the interactions between soil and aerial biodiversity? (p182)

Brainstorming

Brainstorming

References

- http://www.fertilizer.co.za/knowledge-centre/sustainability/263-soil-health-looking-beyond-soil-fertility
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Biodiversity Group

AFD ACTAE cirad INRA

ACP, Diamondback moth (*Plutella xylostella)* management on cabbage fields in Cambodia, Laos and Vietnam


By Biodiversity of vegetable team group

Insect pest cause significant


The purpose

- High yield
- People healthy,
- Reduce chemical pesticide use,
- Safe cost,
- Safe environment

What we needed to do ?

- Conservation biological control:
  - Release parasitoid wasp (*Cotesia plutella)*;


  - Conservation of benefit insect (spiders, predator bugs)


What we needed to do?

- Habitat management:
  - Flowering (*Latana camara*);
  - inter-cropping;

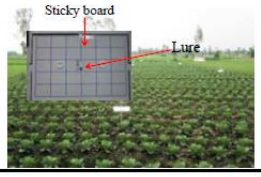



What we needed to do?

- Habitat management:
  - application organic fertilizers with beneficial organisms (*Trichoderma, Actinomyces,*);
  - non-disturbance tillage;
  - good irritation.

What we needed to do?

- Suppression of pesticide use (alternate/replace the use pesticides with natural substances):
  - essential wasabi oil;
  - cabbage bait;
  - bio-products (*Metarhizium*)



Recommendation

- How to integrate and develop to biodiversity:
  - More success we need ACP;
  - We should work together (Policy maker, plant science, soil science, entomologists, pathologists, enterprises and also farmers);
  - Linking to national and regional agencies

What we needed to do?

- Suppression of pesticide use (alternate/replace the use pesticides with natural substances):
  - cabbage bait;
  - bio-products (*Metarhizium,*)

Thank you for your attention

What research need in the field

- ACP DBM management on cabbage fields
- + Conservation biological control: cabbage bait, inter-cropping (green onion, garlic), companion planting (mints); release parasitoid wasp (*Cotesia plutella*); flowering (cosmo,);
- + Habitat management: flowering; inter-cropping; non-disturbance tillage; application organic fertilizers with beneficial organisms (Trichoderma, Actinomyces,); good irritation.
- Suppression of pesticide use: alternate/replace the use pesticides with natural substances (essential wasabi oil; bio-products (Metarhizium))

Biodiversity and crop protection

Perspectives for banana and fruit production

Dr. Philippe Tixier
Mrs. Khonesavanh Chittarath
Mrs. Nguyen Khanh Ngoc
Mrs. Nguyen Hong Ung
Mr. Tran Van Khai
Dr. Tran Thi My Hanh

Background

- The popular Cavendish bananas (*Musa* spp., AAA) constitutes about 45% of all bananas grown worldwide (Lescot, 2015).
- Mainland China is the leading producer of Cavendish bananas, and to satisfy local demand for the fruit, commercial production is expanding into neighboring countries such as Laos, Myanmar and Vietnam. The estimate area Chinese investment in Lao PDR for growing banana is 19,375.09 ha.

The problems for banana

Plant protection problems	Biodiversity-based solutions	Needed research
Fusarium TR4	Trichoderma + Bacteria (soil application with compost)	Effect of cover crop Mixture with tree species (e.g. Custard apple, cacao)
Black and yellow sigatoka	Trichoderma + Bacteria (spray)	?
Freckle	Nothing known today	

Background

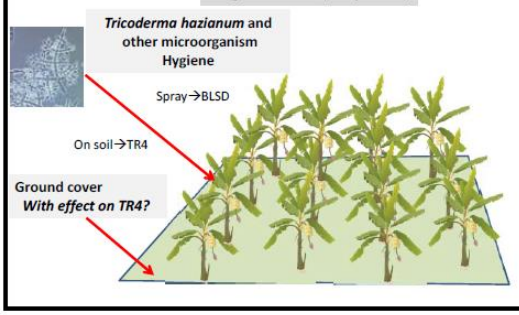
- TR4 are presented in North and Central of Laos.
- At the present TR4 is big problem and lack of technical to control TR4.

The problems for banana

Plant protection problems	Biodiversity-based solutions	Needed research
Fusarium TR4	Trichoderma + Bacteria (soil application with compost)	Effect of cover crop Mixture with tree species (e.g. Ground been, Custard apple, Cassava, Sweet potato)
Black and yellow sigatoka	Trichoderma + Bacteria (spray)	?
Freckle	Nothing known today	

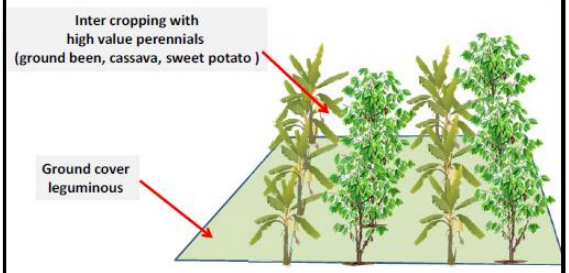
System to be tested: banana

Big farms (export)



System to be tested: banana

Small farms (local market and export)



CITRUS **is a genus of flowering trees and shrubs in the Rutaceae family. Plants in the genus produce citrus fruits, including important crops like pomelo, orange, lemon, …**

Total area of citrus approximately is 140,000 ha with productivity of 1,300,000 ton/year.

There are 78 different kind of insect pests on citrus in Vietnam.

Export value of major fruit and their destination (Mil. USD)

Fruit	2008	2009	2010	2011	2012	2013	Export destination
Total of all fruit	-	-	152.4	260.0	360.0	456.0	-
Banana	-	-	-	-	-		China, Japan, UK, Ukraine
Pineapple	-	-	-	-	-	-	Canned fruits to US, EU, Russia, Taiwan
Mango			3.6	5.0	6.3	7.8	Korea (50%), Japan, China, US
Longan	-	-	-	-	-	-	China, US, Japan
Lychee,	-	-	-	-	-	-	China, Japan, canned fruit to EU
Rambutan	-	-	2.5	6.6	6.7	7.1	US, China, Middle East nations, EU
Citrus (excl. pomelo)	1.4	-	-	-	-	-	China, Cambodia
Pomelo	1.3	-	2.3	4.2	3.6	5.6	The Netherlands, Canada, Russia, Singapore
Dragon fruit	24.2	39	59	107.0	181.0	203.0	China (80%), Asian nations, US, the Netherlands, Japan, Korea

SOFRI, 2014

The main pest problems on citrus

Plant protection problems	Biodiversity-based solutions	Needed research
Asian Citrus Psyllid Mealybug Thrips Mite Fruit fly Fruit borer	• Hygiene • Barrier plants • Bagging • Traps (yellow sticky traps, pheromone traps) • Intercropping with guava	**Effect of** • Cover crop, • Augmentorium • Predator (ladybugs, green ants, …) • Entomopathogenic • Parasitoid

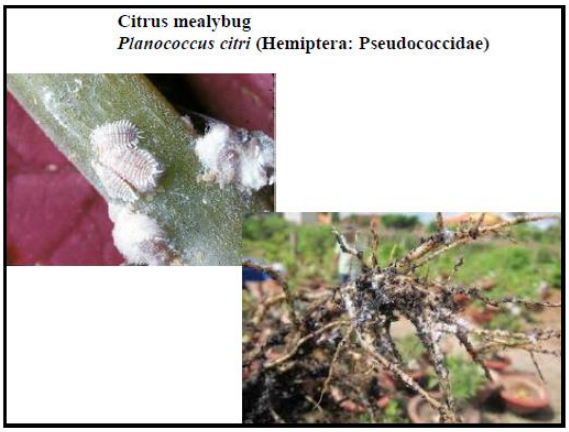
Diaphorina citri – Vector of Citrus huanglongbin

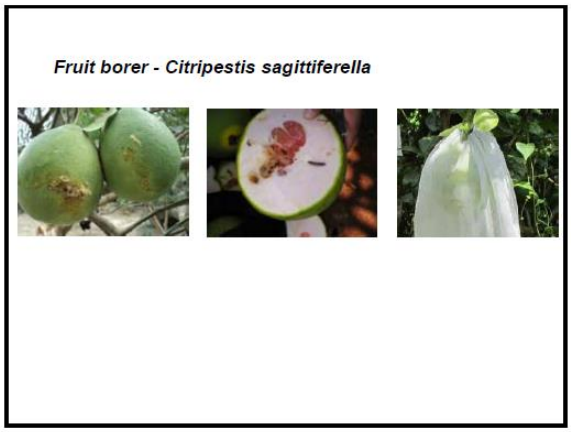
Asian Citrus Psyllid, *Diaphorina citri*

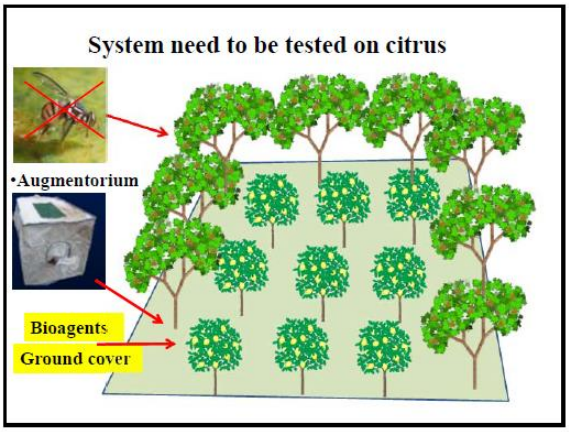
Red mite - Panonychus citri

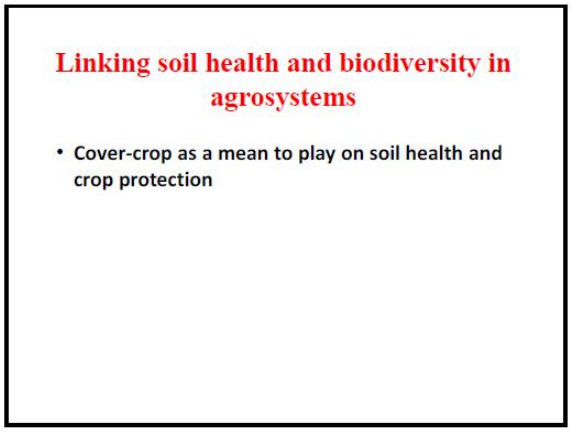

Yellow mite (*Phyllocoptruta oleivora*)


Fig. Citrus thrips: *Thrips nilgiriensis*
Cosmetic damage
Natural enemies help, but don't bring scarring below an economic threshold
Predatory mite, *Eviseius fulgrensis*


Citrus mealybug
Planococcus citri (Hemiptera: Pseudococcidae)


Fruit borer - Citripestis sagittiferella


System need to be tested on citrus
•Augmentorium
Bioagents
Ground cover


Linking soil health and biodiversity in agrosystems
• Cover-crop as a mean to play on soil health and crop protection

Annex 3. Evaluation form of the ISS ACP Can Tho

CANTHO UNIVERSITY

ACP- ACTAE Project Agroecological Crop Protection

Action 4

International Scientist School Agroecological Crop Protection

Can Tho (Vietnam). 11–16 March 2018

Evaluation form

Please fill in this evaluation form and feel free to communicate your reactions. This will help us improve the quality of the school.

1 - The School

1.1 Did the school meet your expectations?

- ○ Not at all
- ○ Not really
- ○ Rather yes
- ○ Yes, totally

Please specify your answer below.

1.2 Did you find the global articulation of the programme (eg alternance of lectures, workshops, team work; density; room left for casual discussions)

- ○ Poor
- ○ Satisfactory
- ○ Good
- ○ Very good
- ○ Excellent

Comments

1.3 Was the school of an appropriate length?

- ○ No
- ○ Yes

Comments

1.4 To your mind, were the objectives of the school met?

	Poor	Satisfactory	Good	Very good	Excellent
To better know and understand the concepts of ACP	○	○	○	○	○
To better know methods and tools for implementation of ACP	○	○	○	○	○
To jointly exchange the principles of ACP	○	○	○	○	○
To engage participants in a collective dynamic of ACP and develop collaborations as well as research projects	○	○	○	○	○
For the collective dynamics, to plan concrete deliverables, videos, articles, and training resources	○	○	○	○	○

Please specify your answer.

1.5 Regarding the organisation, how did you find the following items:

	Poor	Satisfactory	Good	Very good	Excellent
Accommodation (bedrooms, food)	○	○	○	○	○
Conference rooms	○	○	○	○	○
Staff availability	○	○	○	○	○
Location	○	○	○	○	○
Upstream organisation (registration, availability to answer questions)	○	○	○	○	○
Local organisation	○	○	○	○	○

2 - The programme step-by-step (lectures, workshops, group projects)

What is your opinion about the following sequences :

2.1. Day 1 : Introduction to the ISS & Agroecological crop Protection - lectures

	Poor	Satisfactory	Good	Very good	Excellent
Challenges and changes in Crop Protection in SEA (Dr Cao Van)	○	○	○	○	○
Principles of ACP (Dr Deguine)	○	○	○	○	○
From IPM to ACP (Dr Cao Van)	○	○	○	○	○
ACP against arthropods (Dr Deguine)	○	○	○	○	○
ACP against pathogens (Dr Aubertot)	○	○	○	○	○
ACP against nematodes (Dr Tixier)	○	○	○	○	○
ACP against weeds (Dr Cao Van and Dr Sen)	○	○	○	○	○

Comments

2.2. Day 2: Modelling - lectures and group projects

	Poor	Satisfactory	Good	Very good	Excellent
Introduction to modelling (Dr Aubertot)	○	○	○	○	○
Example of modelling: qualitative modelling using IPSIM(Dr Nguyen Thi Ngoc Truc)	○	○	○	○	○
Example of modelling: Management of banana weevils (Dr Tixier)	○	○	○	○	○
Example of modelling: IPSIM Chayote in Réunion (Dr Deguine)	○	○	○	○	○
Approaches & Methodology (Dr Aubertot)	○	○	○	○	○
How to produce knwoledge in Science? (Dr Aubertot)	○	○	○	○	○
Definition of SEA modelling projects (Dr Aubertot)	○	○	○	○	○
Group session on modelling projects	○	○	○	○	○

2.3. Day 4: ACP research topics & Case studies

	Poor	Satisfactory	Good	Very good	Excellent
The need of new approaches in Crop Protection: case study and lessons (Dr Kris Wyckhuys)	○	○	○	○	○
Biocontrol: Semiochemicals (Pr Le Van Vang)	○	○	○	○	○
Biocontrol: Bioproducts (Dr Nguyen Thi Ngoc Truc)	○	○	○	○	○
Functional Biodiversity: banana (Dr Tixier)	○	○	○	○	○
Functional Biodiversity: mango (Dr Deguine	○	○	○	○	○
Soil Health: Conservation agriculture in SEA (Dr Sen)	○	○	○	○	○
Soil Health: Mekong Delta case (Dr Duong Minh Vien)	○	○	○	○	○
Soil Health: impacts of pesticides in the soil (Dr Duong Minh Vien)	○	○	○	○	○
Case study: ACP Rice in Mekong Delta (Pr Le Van Vang)	○	○	○	○	○
Case study: Banana in West Indies (Dr Tixier)	○	○	○	○	○
Case study: Quantification of pest populations and injuries, with specific references to French agriculture (Dr Aubertot)	○	○	○	○	○

Comments

2.4. Day 5: Restitution and conclusion

	Poor	Satisfactory	Good	Very good	Excellent
Restitution of the WS Biodiversity & BC (Dr Nguyen Thi Ngoc Truc, Dr Tixier & Pr Le Van Vang)	○	○	○	○	○
Restitution of the WS Soil health (Dr Cao Van, Pr Duong Minh Vien & Dr Tran Van Thinh)	○	○	○	○	○
Restitution of the modelling projects (Dr Aubertot and participants)	○	○	○	○	○
ISS feedback (Dr Nguyen Thi Ngoc Truc & Pr Le Van Vang)	○	○	○	○	○
Links between Volterra and Can Tho ISS (Dr Aubertot & Dr Wyckhuys)	○	○	○	○	○
Perspectives (D)r Cao Van	○	○	○	○	○
Closing session (CTU Representative)	○	○	○	○	○

Comments

2.4. Day 5: Restitution and conclusion

	Poor	Satisfactory	Good	Very good	Excellent
Restitution of the WS Biodiversity & BC (Dr Nguyen Thi Ngoc Truc, Dr Tixier & Pr Le Van Vang)	○	○	○	○	○
Restitution of the WS Soil health (Dr Cao Van, Pr Duong Minh Vien & Dr Tran Van Thinh)	○	○	○	○	○
Restitution of the modelling projects (Dr Aubertot and participants)	○	○	○	○	○
ISS feedback (Dr Nguyen Thi Ngoc Truc & Pr Le Van Vang)	○	○	○	○	○
Links between Volterra and Can Tho ISS (Dr Aubertot & Dr Wyckhuys)	○	○	○	○	○
Perspectives (D)r Cao Van	○	○	○	○	○
Closing session (CTU Representative)	○	○	○	○	○

Comments

2.5. Days 1 - 2 - 4: Parallel workshops (please answer for the workshop you attended)

	Poor	Satisfactory	Good	Very good	Excellent
Workshop 1 - Biodiversity & BC	○	○	○	○	○
Workshop 2 - Soil health	○	○	○	○	○

Comments

3. General evaluation

To your mind, what are the two or three take-home messages of this school?

What action(s) discussed during the school do you intend to implement in your own research activity?

What are the challenges or questions that were not addressed or answered during the school?

What follow-ups would you like to this school?

4. Other remarks

Would you like to add other comments regarding this training course?

- ○ No
- ○ Yes

Please specify and explain.

5. Identity (optional)

SURNAME, first name